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Module Introduction

Overview

SCSI (pronounced **skuh'-zee**) stands for Small Computer System Interface. It is a parallel interface that many manufacturers use to provide a standard means for connecting computers and peripheral devices such as hard disk drives, printers, and scanners.

SCSI offers users several advantages:

- Speed: SCSI transfers information between a computer and SCSI peripheral devices much faster than other interfaces.
- Flexibility: SCSI is a standard interface, so you can use existing system software to communicate with SCSI devices from different manufacturers.
- Expandability: You can connect as many as seven peripheral devices to a Macintosh computer, or as many as four peripheral devices to one SCSI card in the Apple II computer. (You can install more than one SCSI card in an Apple II.)

Setting up a network using the SCSI Cable System consists of three general tasks:

- connecting the appropriate cables to the computer and the other SCSI devices
- properly terminating the network
- ensuring that each device has a unique identification (priority) number

This module provides the information you need to connect SCSI devices to Apple II computers. In the next module "Hard Disk SC," you will apply this knowledge as you connect an Apple SCSI hard disk to an Apple IIGS computer.

Module Introduction

What You Will Learn

In this module, you will learn how to:

- assign priority numbers to devices
- use the right type of cable for each connection
- terminate a SCSI network

The Skills Checklist following this Module Introduction lists, in detail, the tasks you should be able to perform upon completion of this module.

How You Will Be Tested

You will demonstrate your knowledge about SCSI basics in two tests:

The Module Test - is a written test that will help you verify that you have achieved the skills listed in the Skills Checklist.

The Prerequisite Exam - consisting of written and hands-on items, this test will verify that you can perform the tasks listed on the Skills Checklist and that you are ready for the Lab part of this course.

During the Lab part of this course, you will be expected to connect SCSI devices during hands-on exercises.

Prerequisites to this Module

Before beginning this module, you must have satisfactorily completed these modules:

- Welcome to Apple Service
- Apple II Basic Features
- Setting Up Apple II Computers
- Using Apple II Computers

Materials Provided for this Module

The Prerequisite provides the following items for this module:

- This Module Workbook
- Module Test

Module Introduction

Materials You Need to Provide

You do not need any additional materials to complete this module. If you have SCSI cables and terminators available, you may want to examine them as you read about them in this module.

How the Module Is Organized

This module is presented in two parts.

Part 1 - Setting Priorities Among SCSI Devices—This part explains what SCSI priority numbers are, why they are important, and how to set them.

Part 2 - SCSI Cables and Terminators—This part describes the three SCSI cables, explains when to use them and explains how to properly position the SCSI terminators.

Following these two parts is the Module Summary.

Continue with the Skills Checklist on the following pages.

Skills Checklist

What Is the Skills Checklist?

This is a list of tasks that you should be able to perform at the conclusion of this module. The Prerequisite Exam (written and hands-on) will cover these items. During the Lab part of this course, you will be expected to be able to perform all of these tasks.

How to Use the Checklist

Before starting this module, check the items on this list to see which tasks you can already perform. If you are confident that you can already perform certain tasks, you may decide to skip those parts of the module. Or you may decide to try the Module Test without going through the module.

After completing the module, check this list to make certain that you have mastered all the skills before you attend the Prerequisite Exam and the Lab part of this course. If you feel uncertain about any of these tasks, return to the section indicated, review the information and repeat the hands-on exercises.

Skills Checklist

	Task	**Section Where the Task is Covered**
____	1. State the maximum number of SCSI devices that you can connect to Apple II computers.	Setting Priorities Among SCSI Devices
____	2. Explain why each SCSI device on a network must have a unique SCSI ID number.	Setting Priorities Among SCSI Devices
____	3. For a given situation involving an Apple II computer and a variety of SCSI devices, assign SCSI priority numbers and indicate the slots in which you would place the Apple II SCSI Card(s).	Setting Priorities Among SCSI Devices
____	4. Explain why you cannot connect SCSI devices to Apple IIc computers.	Setting Priorities Among SCSI Devices
____	5. Identify the three types of SCSI cables.	SCSI Cables and Terminators
____	6. Indicate which type of SCSI cable should be used for a given configuration.	SCSI Cables and Terminators
____	7. Determine whether or not a SCSI network is properly terminated.	SCSI Cables and Terminators
____	8. Identify the devices on a SCSI network that must be powered on for the network to function properly.	SCSI Cables and Terminators

Continue with the next section - Setting Priorities Among SCSI Devices.

Setting Priorities Among SCSI Devices

Introduction

This module explains what SCSI priority numbers are, why they are important, and how to set them. This module begins by explaining a few key terms.

SCSI Terms

A **SCSI bus** is a physical path on which electronic data travels.

A **SCSI device** is any computer or peripheral product that can communicate on a SCSI bus. A SCSI device may be built into a computer (an internal SCSI device) or attached to the computer with the SCSI Cable System (an external device).

A **SCSI chain or network** is a group of SCSI devices connected by SCSI cables. For example, an Apple IIGS connected to a SCSI hard disk and a CD-ROM drive form a SCSI chain or network, as shown in Figure 1. A SCSI chain can have up to seven devices in addition to the computer.

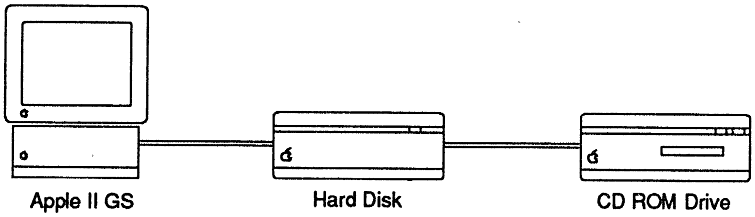


Figure 1. Example of a SCSI chain

Setting Priorities Among SCSI Devices

SCSI ID Numbers

Each device on a SCSI bus has a **SCSI identification number** ("ID number" or "priority number"). The computer uses the ID numbers to identify devices on the bus. The SCSI ID number identifies each device regardless of its physical location in the SCSI chain.

The ID number also determines which device communicates first when more than one device wants to use the bus. Eight numbers (0-7) are used to establish identity and priority on the SCSI bus. The higher the number, the higher the priority given for using the SCSI bus. Generally, the computer is assigned priority 7, making it the highest priority device.

Factory-Set Numbers

At the factory, similar products are assigned the same SCSI ID number. For example, all Apple SCSI external hard disks are assigned the ID number 5. Here is a list of currently offered Apple SCSI products and their factory-set ID numbers.

• Apple II computers (actually the Apple II SCSI Card)	7
• external SCSI hard disks	5
• LaserWriter SC	4
• AppleCD SC	3
• Apple Scanner	2
• Apple Tape Backup 40SC	1
• internal SCSI hard disks (Macintosh only)	0

SCSI ID Numbers Must Be Unique

Regardless of their factory-set ID numbers, each device on a SCSI network must have a unique ID number. If two devices have the same ID number, they may send data at the same time, which could damage files. Devices with the same priority number can also cause a failure to boot. So remember—**make certain that all SCSI devices on a bus have a unique ID number**.

Setting Priorities Among SCSI Devices

This means that before you connect SCSI devices, you must check their ID numbers to ensure that no two devices have the same number. If you are connecting more than one of the same type of Apple device, you will most likely need to change the ID number of one of them. For example, Apple external hard disks come from the factory with the ID number 5. If you plan to connect two or more of the hard disks on one SCSI bus, you will have to change one of the numbers so that each hard disk has a unique number.

Do not assume that the devices still have their factory settings. **Make it a rule to check all ID settings before connecting SCSI devices!**

Setting ID Numbers

You can set the ID numbers of most SCSI peripheral devices by using a physical mechanism. For some devices, like Apple external SCSI hard disks, you set the number on a thumbwheel or a switch, as shown in Figure 2. For other devices, like the Apple LaserWriter SC, you change the ID number by setting DIP switches. For some third-party products, you use a software application to set the priority. For exact instructions, consult the Owner's Manual for each device involved.

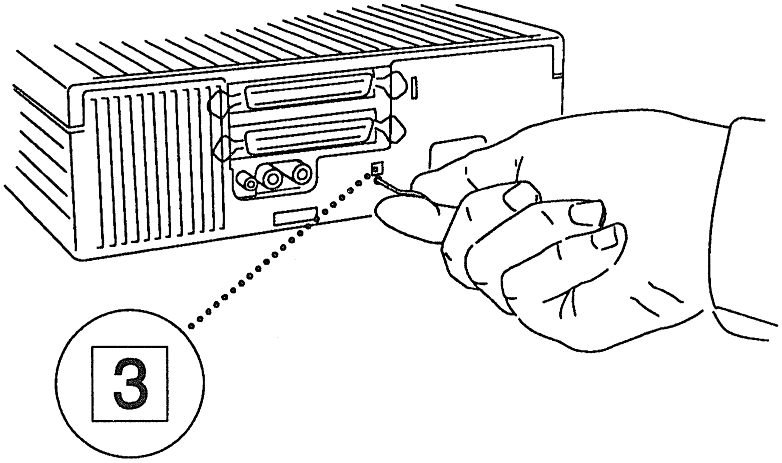


Figure 2. Using a paper clip to change the priority number of an Apple SCSI hard disk

Setting Priorities Among SCSI Devices

Determining Priorities

In general, you should assign the higher priorities to startup devices. For example, a hard disk that is configured as the startup disk should rank just after the computer. The computer is usually 7, so the hard disk would be priority 6 or 5. Remember that when the system scans through the SCSI devices for a startup disk, the system searches from the highest priority number to the lowest.

You can assign the lower priority numbers to the least-used equipment. For example, The Apple Tape Backup 40SC, which you use less often than a startup disk (and never boot from), is factory-set at ID number 1.

SCSI with Apple II Computers

To use SCSI devices with the Apple II family of computers, you need to install an Apple II SCSI Card in the computer and connect the SCSI devices to the card. This means that the Apple IIc and the Apple IIc Plus, which do not have slots for interface cards, cannot use SCSI. The information presented in this module, therefore, applies to all Apple II computers except the Apple IIc and the Apple IIc Plus.

Note: *The Apple II SCSI Card will not work with the older DOS operating system. You must use the ProDOS operating system.*

Slots

You can install an Apple II SCSI Card into any Apple II general purpose expansion slot except slot 3 (which is used to add 80-column capability to the computer).

If you put the card in slot 5, you can connect up to four peripheral devices to one SCSI Card (with ProDOS version 1.2 or later). In any other slot, a card can support only two devices. Versions prior to ProDOS 1.2, only permit two SCSI devices connected to each card regardless of the slot.

Due to ProDOS limitations and the available slots in your Apple II computer, the Apple IIe and Apple IIGS support a maximum of seven SCSI devices. ProDOS version 1.2 or later, allows you to connect up to four devices to one card in slot 5 and up to two devices to an additional card in another slot.

Setting Priorities Among SCSI Devices

The SCSI Card ID Number

The Apple II SCSI Card controls the exchange of data on the SCSI bus. The SCSI card itself is considered a SCSI device and, as such, has a SCSI ID number. (With an Apple II computer, the Apple II CPU is not actually a SCSI device; the SCSI card which you add to the Apple II CPU is the SCSI device.) The SCSI card is assigned the highest priority number, 7.

Generally you should not have to change the ID setting on the SCSI card, but you might need to verify that it is set correctly. The SCSI card has a jumper block with metal pins in the upper left corner. The jumper (the small, plastic, rectangular connector) should be on the two pins to the far right of the jumper block as shown in Figure 3. In this position, the computer has priority number 7.

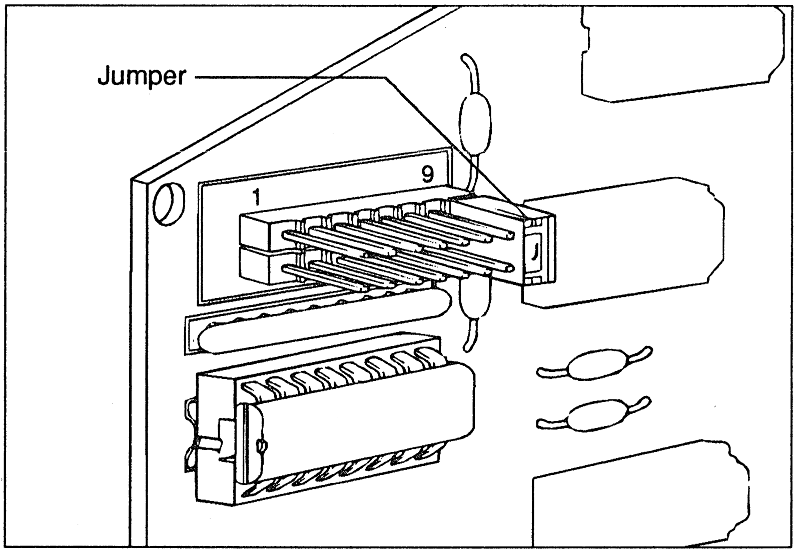


Figure 3. Standard position for the Apple II SCSI Card SCSI ID jumper

Setting Priorities Among SCSI Devices

The numbers 1 through 16 etched on the card above and below the connector indicate connector pin numbers, *not* SCSI ID numbers. Each vertical *pair* of pins corresponds to a SCSI ID number and priority.

When positioned properly, the jumper covers the two pins underneath the number 9. When troubleshooting Apple II and SCSI device problems, check to make sure the jumper is in this position.

Remember—you should never have to move this jumper. Moving the jumper to the left lowers the priority of the computer on the SCSI bus and may lead to problems during start-up.

Slots and Priority Numbers

ProDOS uses the priority number you assign each device to interpret which device is Drive 1 and which is Drive 2 of a given slot. ProDOS recognizes the device with the highest SCSI priority number as Drive 1 and recognizes the device with the next highest priority number as Drive 2. If the Apple II SCSI Card is in slot 5 and you have more than two devices attached, ProDOS interprets the device with the third highest priority number as Drive 1, Slot 2. ProDOS interprets the lowest priority device as Drive 2, Slot 2. Normally, Apple II hardware only allows two bootable SCSI devices per slot. ProDOS compensates for this hardware limitation by "tricking" the hardware into thinking that the devices with the third and fourth highest priorities are connected to an Apple II SCSI Card in Slot 2.

If you connect four SCSI devices to a card in slot 5, you must be careful not to install a floppy disk drive controller card in slot 2. Remember that the Apple II "thinks" that the last two SCSI devices connected to the Apple II SCSI Card in slot 5 are connected to a SCSI Card in Slot 2. You can still use Slot 2 for a card that connects to a non-bootable device, such as serial printer or modem.

Apple IIe Start-up Search

When searching for startup files, the Apple IIe searches from high-numbered slots to low-numbered slots. If you want to boot from a hard disk, assign it priority 6, and make sure the SCSI card is in a higher slot than any other disk controller card. As the computer searches through the SCSI devices for a startup disk, the computer will find the hard disk first.

Setting Priorities Among SCSI Devices

Example of SCSI Priorities

As an example, if you have an Apple IIe with three Hard Disk 20SCs and a tape backup drive, you could connect them all to a SCSI card in slot 5. Table 1 indicates how ProDOS would interpret each device with the following SCSI ID numbers:

Device	With ID of	ProDOS interprets as
Hard Disk 20SC	6	Drive 1, Slot 5
Hard Disk 20SC	5	Drive 2, Slot 5
Hard Disk 20SC	4	Drive 1, Slot 2
Tape Backup	0	Drive 2, Slot 2

Table 1

The Apple IIe would boot from the HD20SC that has ID 6 except when a diskette is inserted in a floppy drive.

Apple IIGS Startup Search

The Apple IIGS Control Panel can be used to designate which slot you want the computer to start up from. You do not have to connect the startup device to the card in the highest-numbered slot. By setting the Startup Slot to Scan in the Control Panel, the Apple IIGS will scan from the highest to the lowest numbered slots for a bootable device. For more information on setting Apple IIGS slot assignments, refer to the module entitled *Using Apple II Computers.*

Continue with the next section - Exercise: Setting Priorities Among SCSI Devices.

Exercise: Setting Priorities Among SCSI Devices

For items 1 through 4, write the information requested.

1. What is the maximum number of SCSI peripheral devices you can attach to an Apple IIGS or Apple IIe computer?

   7 devices

2. Why can't you use SCSI devices with the Apple IIc or Apple IIc Plus computers?

   Apple IIc's have no slots so you can't install a SCSI Card

3. Complete these two statements:

   If you want to connect four peripheral devices to one SCSI card in an Apple IIGS, you should put the SCSI card in slot number 5

   ProDOS will interpret the third and fourth devices as Drives 1 and 2 of slot number 2

4. Under normal circumstances, what is the ID number of the Apple II SCSI Card?

   6

Exercise: Setting Priorities Among SCSI Devices

For items 5 through 8, indicate if the statements are correct or incorrect by checking TRUE or FALSE.

5. All devices of the same type (for example, all printers) should have the same priority number when connected to a SCSI network.

   ___ TRUE ✓ FALSE

6. Prior to ProDOS 1.2, each SCSI card could support only two SCSI devices.

   ✓ TRUE ___ FALSE

7 If you connect two devices to a SCSI card in an Apple IIGS, ProDOS will interpret the device with the higher priority number as Drive 1 of the slot containing the SCSI card.

   ✓ TRUE ___ FALSE

8. You can designate the preferred startup disk using the Apple IIGS Control Panel.

   ✓ TRUE ___ FALSE

Exercise: Setting Priorities Among SCSI Devices

Item 9 has three parts. Answer as indicated.

9. Assume that you are setting up a SCSI network that includes an Apple IIGS (with ProDOS 2.1), two Apple external SCSI hard disks, an Apple Tape Backup 40SC, an Apple LaserWriter SC, and an AppleCD SC. All of the devices still have their factory-set SCSI ID numbers.

   a. Would you have to change any ID number(s) for this SCSI chain? If so, for which device(s)? What number(s) would you assign them?

   Change one of the hard drives the others can be left set as is

   b. What is the minimum number of Apple II SCSI Cards that you need to install in the Apple IIGS to support the devices listed above?

   2 SCSI Card(s)

   c. In which slot or slots would you put the SCSI Card(s)?

   Card supporting 4 in slot 5 other card anywhere except 3

Compare your answers to those on the following pages.

Exercise: Setting Priorities Among SCSI Devices (Answers)

Compare your answers to those below.

1. 7
2. Apple IIc computers do not have any slots, so you can't install an Apple II SCSI Card.
3. If you want to connect four peripheral devices to one SCSI Card in an Apple IIGS, you should put the SCSI card in slot number **five**.

   ProDOS will interpret the third and fourth devices as Drives 1 and 2 of slot number **two**.
4. 7
5. FALSE - All devices on a SCSI network must have a unique number.
6. TRUE
7. TRUE
8. TRUE
9. a. You would have to change the ID number for one of the hard disks. The hard disk to be used as a startup disk should have the higher priority number, so you would probably change it to 6 and leave the other hard disk set at 5.

      The other ID numbers can be left at the factory-settings.

   b. The minimum would be two Apple II SCSI Cards.

   c. One SCSI card supporting four devices would have to be installed in slot 5. The other card (to support the fifth device) could be installed in any other slot except 3.

      Remember that slot 3 is used for 80-column capability.

Exercise: Setting Priorities Among SCSI Devices (Answers)

Directions

If you missed any of these items, review the section entitled "Setting Priorities Among SCSI Devices."

If you completed the items correctly....

Continue with the next section - SCSI Cables and Terminators.

SCSI Cables and Terminators

Overview

Setting up a SCSI network requires that you know how to use the various SCSI cables and know how to terminate the system. Improper cabling and termination can result in system malfunctions or damage.

In this section, you will learn:

- how to identify the three SCSI cables
- when to use each cable
- how to terminate a SCSI network

SCSI Cables

There are three types of SCSI cables. As you read the description of each cable, look at Figure 4 for illustrations of the three cables.

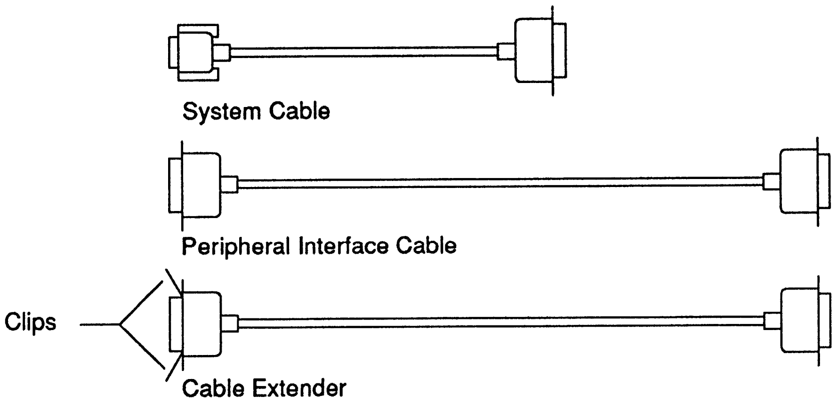


Figure 4. Three types of SCSI cable

System Cable

The System Cable is 18 inches long and is the shortest of the three SCSI cables. One end of the cable has DB-25 connector, which connects to the Apple II SCSI Card. The other end of the System Cable has a 50-pin connector, which plugs into a SCSI peripheral device or a Cable Terminator. (You will learn about Cable Terminators later in this section). Figure 5 shows an example of the how the System Cable is used. In all SCSI networks only one System Cable is used.

SCSI Cables and Terminators

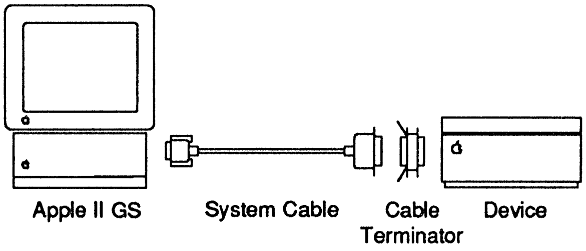


Figure 5. Example of a System Cable connecting a computer to an external SCSI device.

Peripheral Interface Cable

The Peripheral Interface Cable shown in Figure 4 is approximately three feet long and has *identical* 50-pin connectors on each end. The inside of each connector is recessed and lined with gold ribbon pins. If you have more than one SCSI peripheral device, you use this cable to connect the peripheral devices to each other. You can not use a Peripheral Interface Cable to connect a computer to a peripheral device.

Figure 6 shows one Peripheral Interface Cable attached to one additional device. Figure 7 shows multiple Peripheral Interface Cables attached to multiple devices.

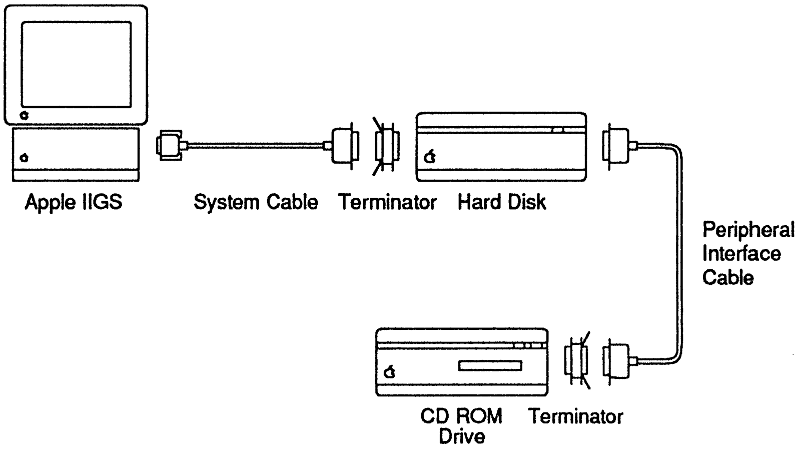


Figure 6. Example of one Peripheral Interface Cable connecting additional external devices

SCSI Cables and Terminators

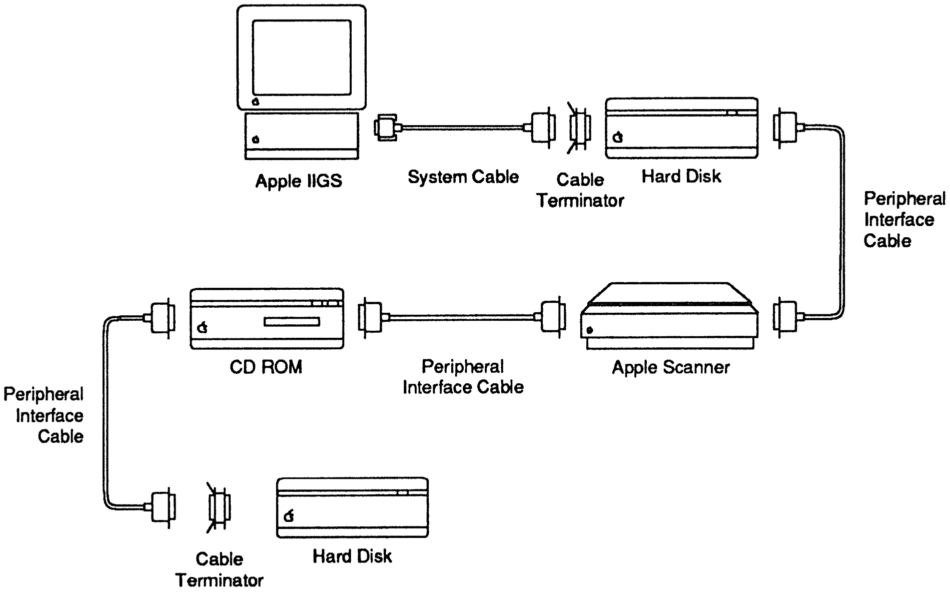


Figure 7. Example of multiple Peripheral Interface Cables connecting additional external devices

Cable Extender

The Cable Extender shown in Figure 4 is the same length as the Peripheral Interface Cable (3 feet), but the Cable Extender has *different* 50-pin connectors at each end. One 50-pin connector is recessed and has binding clips that you attach to a Peripheral Interface Cable, to the System Cable 50-pin connector or to another Cable Extender. The other 50-pin connector has protruding pins. You attach this connector to a Cable Terminator or to the next device.

You use the Cable Extender like an extension cord. You can add Cable Extenders at any point in the chain if the devices are too far apart for the System Cable or Peripheral Cable to connect them. You can connect several Cable Extenders together, if you need to, as long as the total length of the SCSI network is not more than 20 feet (6.5 meters). **The maximum length of a SCSI network is 20 feet**. See Figures 8 and 9 for examples of how Cable Extenders can be used.

Notice, as shown in Figures 8 and 9, that Cable Extenders always have clips on one connector end.

SCSI Cables and Terminators

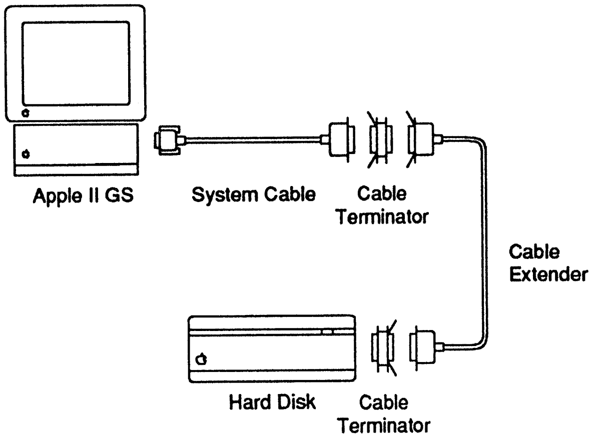


Figure 8. Example of the use of one Cable Extender

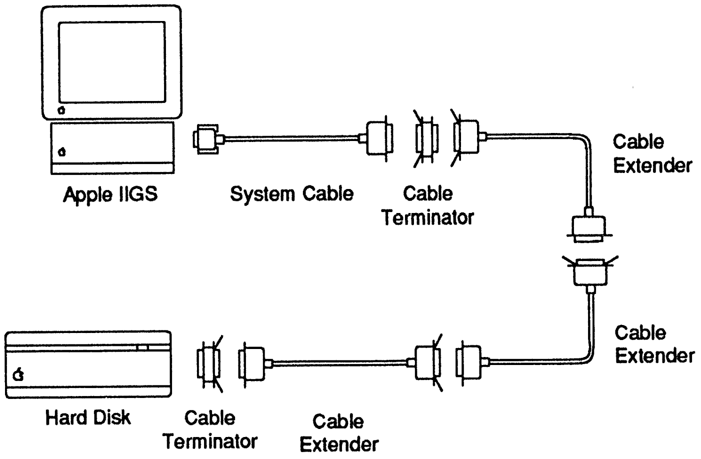
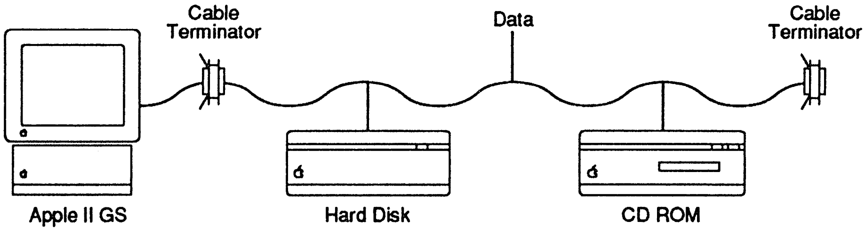


Figure 9. Example of the use of multiple Cable Extenders

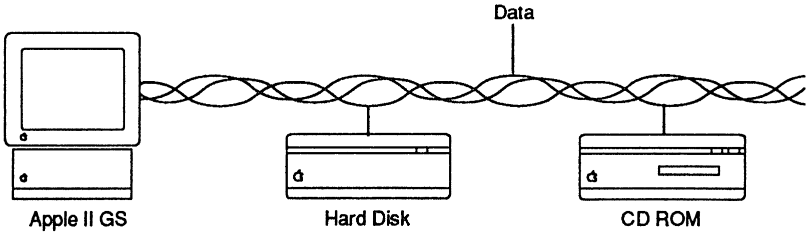
SCSI Cables and Terminators

SCSI Termination

Electrically terminated resistors are required to ensure signal integrity along a SCSI bus. These resistors control voltage range and keep signals from bouncing off one end of the line and rippling back interfering with new messages. Figure 10 compares a properly terminated SCSI bus to an improperly terminated SCSI bus.



With proper termination



Without proper termination

Figure 10. Comparison of a SCSI bus with terminators and a bus without terminators

Any SCSI network that is more than one System Cable long must be terminated at each end. If the network is only one cable long (the System Cable), you need only one terminator. A SCSI network should never have more than two terminators (one at each end). A SCSI network with more than two terminators may cause intermittent problems, inhibit booting or damage SCSI circuits within devices.

SCSI Cables and Terminators

SCSI Cable Terminator

A Cable Terminator is a plastic case containing electrically terminated resistors, as shown in Figure 11. You attach Cable Terminators either to a SCSI port on a SCSI device or to one of the three SCSI cables.

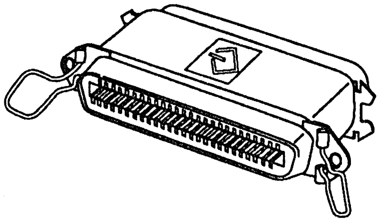


Figure 11. A SCSI Cable Terminator

Built-in Terminators

Some SCSI devices have built-in terminators—electrically terminated resistor packs that are plugged into sockets on the circuit board of a device. Figure 12 shows a SCSI device with built-in terminating resistors.

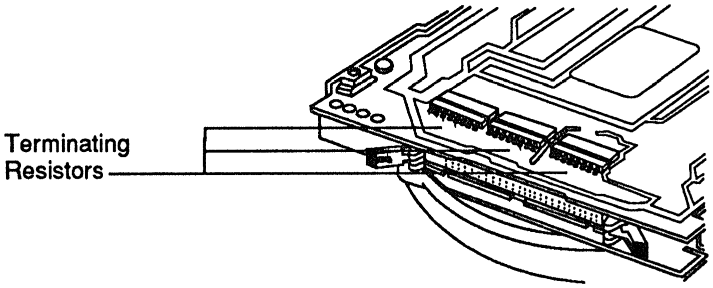


Figure 12. Terminating resistors built into a Apple internal SCSI hard disk

All Apple internal SCSI hard disks have built-in terminators. All Apple external SCSI devices do not have built-in terminators. Apple II computers can only be used with external SCSI devices.

SCSI Cables and Terminators

Guidelines for Positioning SCSI Terminators

The number and positioning of terminators depends on how many devices you are connecting, the distance between devices and if the devices have internal terminators. Study the following guidelines and examples to understand where to place Cable Terminators.

- If you attach only one external SCSI device to a computer with the Apple SCSI System Cable, attach one Cable Terminator. Because the System Cable is only 18 inches long, one terminator is sufficient to control the voltage range and protect the signals from reflecting back on the cable.
- Make sure the first peripheral device and the last peripheral device in your SCSI chain are terminated (either internally or externally).
- Some third-party SCSI devices have built-in terminators. If you have only one such device, place it at the end of your SCSI chain and do not add a Cable Terminator.
- If you have more than one third-party SCSI device that has built-in terminators, make certain that you have only two terminators in the SCSI chain. You must remove the extra terminators (see the device's Owners Manual for instructions). Having too many terminators is as dangerous as having too few!
- If the second terminator you are using is a Cable Terminator, attach it to the last SCSI cable in the chain.
- A SCSI network longer than 18 inches long requires two terminators. If you connect one device to a computer by using a System Cable and a Cable Extender, place a terminator between the System Cable and the Cable Extender as well as attaching a Cable Terminator to the last SCSI cable in the chain.

Figure 13 shows how to organize SCSI devices. Notice the placement of terminators, with one at the beginning of the SCSI chain and one at the end of the chain. These configurations include Apple and third-party SCSI peripheral devices.

SCSI Cables and Terminators

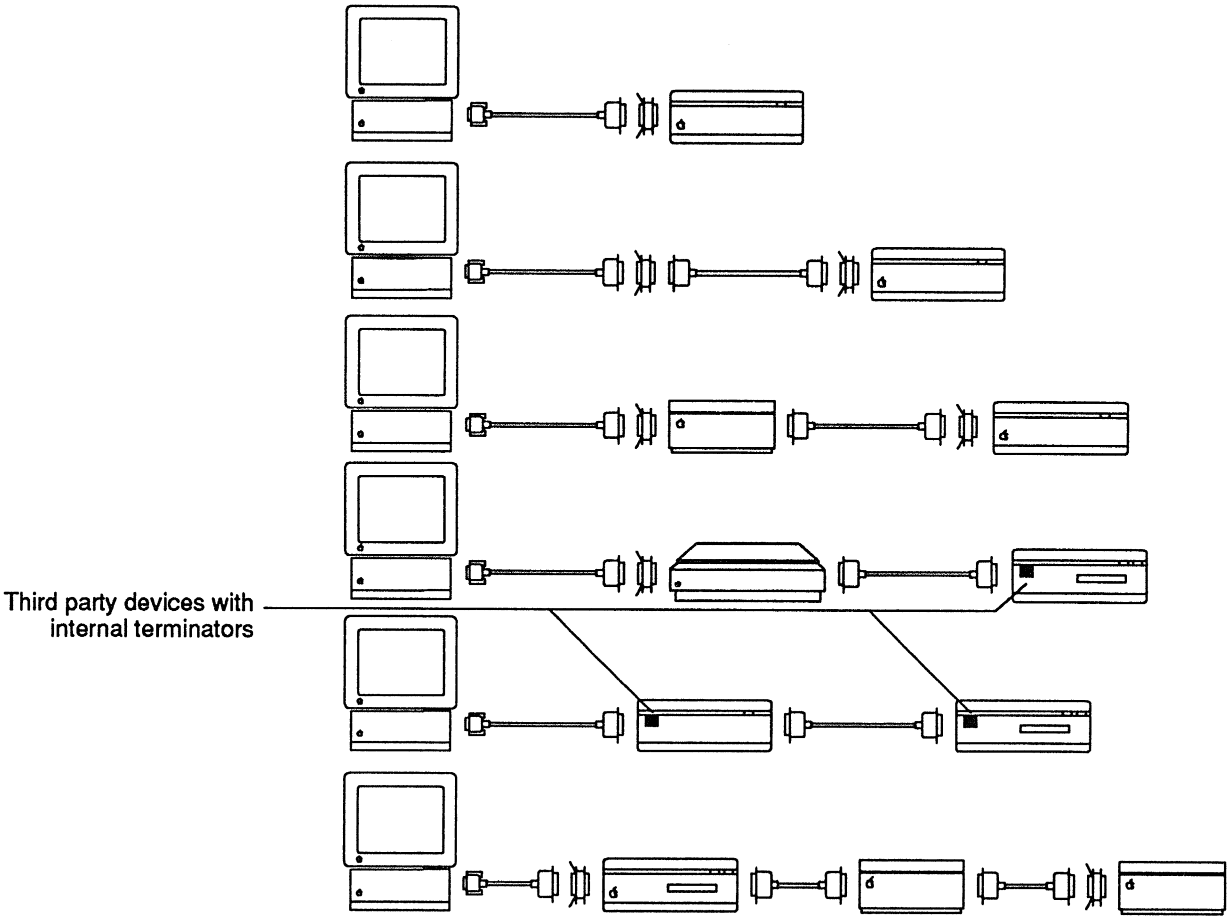


Figure 13. Apple II computers and external SCSI devices

SCSI Cables and Terminators

Summary of SCSI Equipment Needed

Depending on the number and type of devices in your SCSI chain and your space requirements, you will choose a combination of cables and cable terminators. Table 2 shows the equipment you need for various combinations of devices.

Number of peripheral devices and distance from computer or other device	System Cable	Peripheral Interface Cable	Cable Extender	Cable Terminator
1 device *within 18 inches of computer*	Yes	No	No	1
1 device *more than 18 inches from computer*	Yes	No	Yes*	2
2 or more devices *less than 3 feet apart*	Yes	Yes*	No	2
2 or more devices *3 feet or more apart*	Yes	Yes*	Yes*†	2

* You need this type of cable, but the *number* of cables you need depends on the distance between devices and on how many devices you are connecting.

† Remember that you cannot use more than 20 feet of cable.

Table 2. SCSI cable formula for a computer without an internal hard disk (all Apple II computers)

SCSI Cables and Terminators

Powering On a SCSI Network

When you want to use any SCSI devices on a SCSI network, the devices that have the terminators attached (the first and last device) must be turned on in order to pass information through the cable system. If you are not using any devices in the middle of the network, you can leave them switched off.

Consider, for example, the network shown in Figure 14.

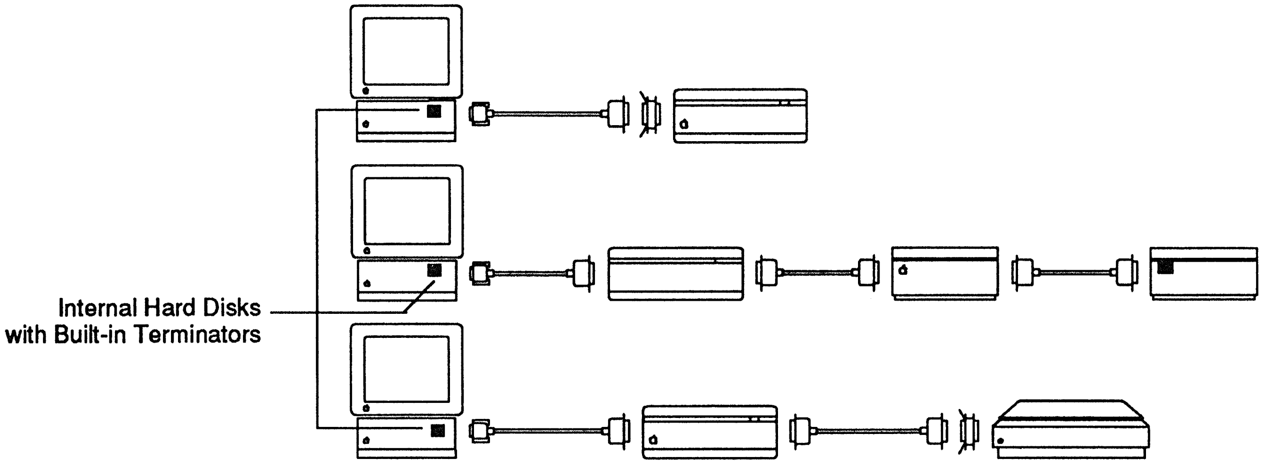


Figure 14. Example of a SCSI network

If the user of this network wants to use only the computer and the hard disk, he needs to power on the printer also because it has the second terminator. He does not have to turn on the Apple Scanner or the CD-ROM drive, which do not have terminators.

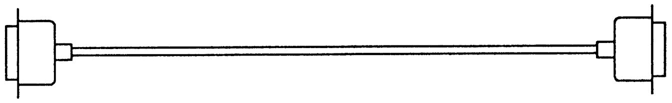
Continue with the next section - Exercise: SCSI Cables and Terminators.

Exercise: SCSI Cables and Terminators

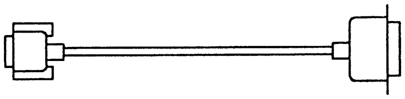
Part 1

Three types of SCSI cables are shown below. For each item, indicate which cable should be used by writing the letter corresponding to the appropriate cable in the blank provided. Where more than one cable is needed, write the letters corresponding to all the cables needed. (For this part, don't worry about where you would place the terminators.)

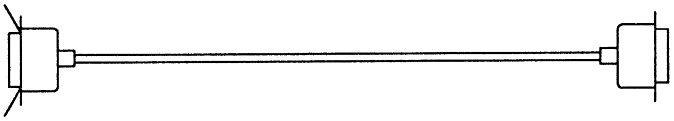
A



B



C



B 1. Connect a computer to a peripheral device that will be positioned within 18 inches.

B+C 2. Connect a computer to a device that will be positioned two feet away.

A 3. Connect a peripheral device to another peripheral device within two feet.

A 4. Connect a peripheral device to another peripheral device within three feet.

A+C 5. Connect a peripheral device to another peripheral device that is five feet away.

Exercise: SCSI Cables and Terminators

Compare your answers for Part 1 to those on the next page.

Exercise: SCSI Cables and Terminators (Answers)

Part 1

Compare your answers to those below.

1. B - System Cable
2. B and C - System Cable and Cable Extender
3. A - Peripheral Interface Cable
4. A - Peripheral Interface Cable
5. A and C - Peripheral Interface Cable and Cable Extender

Continue with Part 2 of this exercise.

Exercise: SCSI Cables and Terminators

Part 2

Answer the following questions as directed.

1. What is the maximum length for a SCSI network?

   20 feet

2. For a SCSI network to function properly, which devices on the network must be turned on? Circle the correct answer.

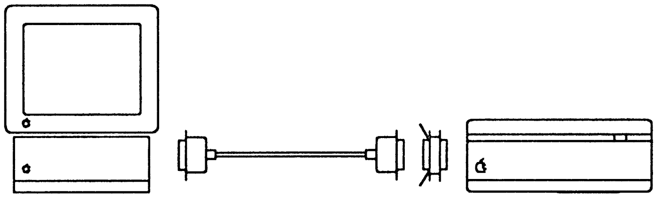
   A. All of the devices on the network.
   [✓ B.] At least the devices that have terminators attached.
   C. Only the computer and the peripheral devices you plan to use.

3. Assume that you are connecting three third-party peripheral devices to an Apple IIGS. The third-party devices have built-in terminators, so you obviously have too many terminators for the network. What should you do?

   Take out a set of the terminators

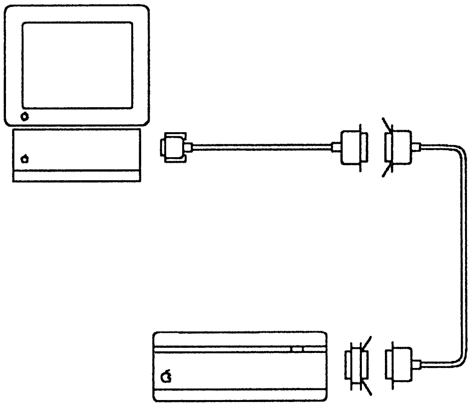
Exercise: SCSI Cables and Terminators

4. Is the following system properly configured? If not, how should it be changed?



A. It's properly configured
B. Remove the terminator
C. Add a terminator between the computer and the cable
[✓ D.] Use a System Cable instead of a Peripheral Interface Cable
E. Remove the terminator and use a System Cable instead of a Peripheral Interface Cable

5. Is the following system properly configured? If not, how should it be changed?



A. It's properly configured
B. Add a terminator between the computer and the System Cable
[✓ C.] Add a terminator between the System Cable and the Cable Extender
D. Use a Peripheral Interface Cable instead of a Cable Extender
E. Move the terminator from to the other end of the Cable Extender

Exercise: SCSI Cables and Terminators

Compare your answers for Part2 to those on the following page.

Exercise: SCSI Cables and Terminators (Answers)

Part 2

Compare your answers to those below.

1. 20 feet
2. B
3. Remove the extra terminator(s) from the third-party devices.
4. D. Use a System Cable instead of a Peripheral Interface Cable.
5. C. Add a terminator between the System Cable and the Cable Extender.

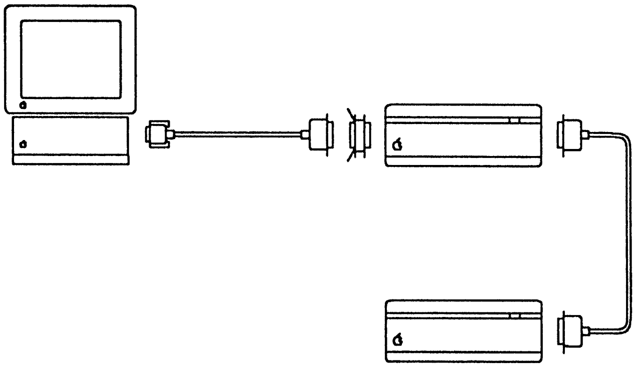
Continue with Part 3 oof this exercise.

Exercise: SCSI Cables and Terminators

Part 3

Answer the following questions as directed.

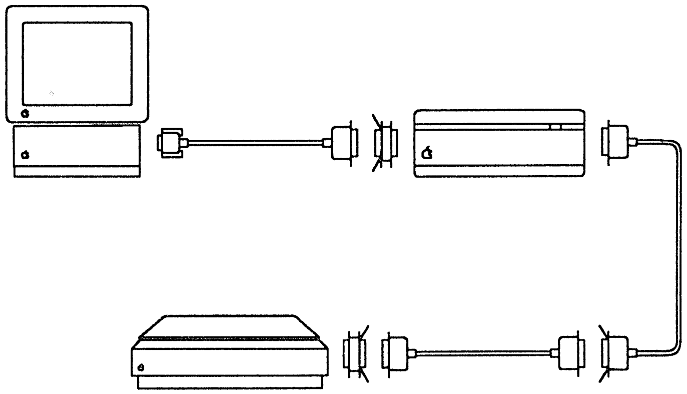
1. Is the following system properly configured? If not, how should it be changed?



A. It's properly configured
B. Remove the first terminator
C. Move the terminator to between the Peripheral Interface Cable and the last Device
[✓ D.] Place an additional teminator between the Peripheral Interface Cable and the last Device
E. Add a Cable Extender between the Peripheral Interface Cable and the last Device

Exercise: SCSI Cables and Terminators

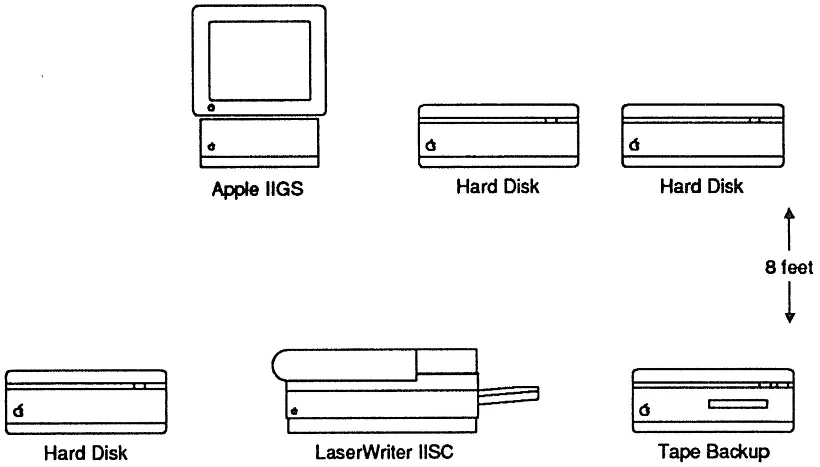
2. Is the following system properly configured? If not, how should it be changed?



[✓ A.] It's properly configured
B. Remove the first terminator
C. Add a terminator between the Peripheral Interface Cable and the last device
D. Use another Peripheral Interface Cable instead of the Cable Extender
E. Move the second terminator to between the Cable Extender and the Peripheral Interface Cable

Exercise: SCSI Cables and Terminators

3. A customer wants to connect three external hard disks, an Apple LaserWriter SC, and an Apple Tape Backup 40SC. She plans to arrange them as shown in the figure below.



a. List the SCSI cables she needs and state how many of each type she will need.

b. How many SCSI Cable Terminators would she need?

c. Where should she place the terminator(s)?

Compare your answers to those on the following page.

Exercise: SCSI Cables and Terminators (Answers)

Part 3

Compare your answers to the following.

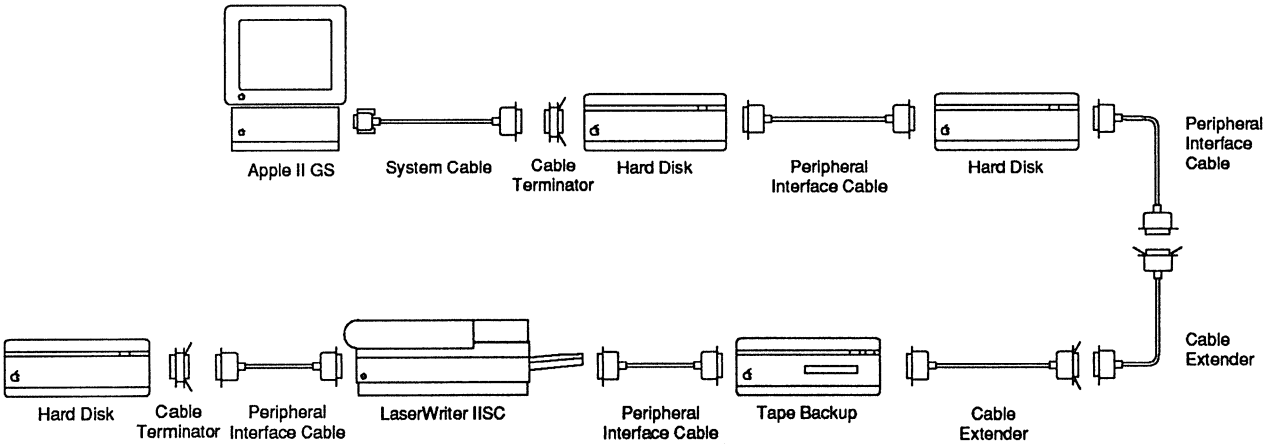
1. D. Place an additional teminator between the Peripheral Interface Cable and the last device.

2. A. It's properly configured.

3. a. 1 System Cable
   4 Peripheral Interface Cables
   2 Cable Extenders

   b. two Cable Terminators

   c. Place one terminator between the System Cable and the first device. Place the second terminator between the last peripheral cable and the last device.



If you missed any of the items in the three parts of this exercise, review the section entitled "SCSI Cables and Terminators."

If you completed all the items correctly....

Continue with the next section - Module Summary.

Module Summary

SCSI, the Small Computer System Interface, is a parallel interface for connecting computers and peripheral devices, such as hard disk drives, printers, or scanners.

Apple SCSI Devices

SCSI devices currently offered by Apple are:

- Apple II computers that have slots (the Apple IIGS and Apple IIe)
- SCSI Hard Disks (20, 40, 80, 160MB)
- LaserWriter SC
- AppleCD SC (CD ROM drive)
- Apple Scanner
- Apple Tape Backup 40SC

Apple II computers can support up to seven other SCSI devices.

Priority Numbers

Each SCSI device on a network must have a unique priority or ID number. The computer uses these numbers to locate and distinguish between each device on the network. SCSI ID numbers range from 0 to 7, with 7 indicating the highest priority.

SCSI devices have factory-set ID numbers, for example, all Apple external SCSI hard disks are set at 5. You should always check the ID numbers on all SCSI devices before connecting them with SCSI cables to ensure that no two devices have the same ID number.

SCSI with Apple II Computers

To attach SCSI devices to an Apple II computer, you need to install an Apple II SCSI Card in one of the computers slots. If an Apple II does not have slots (for example, the Apple IIc and the Apple IIc Plus) it cannot support SCSI devices.

You can install an Apple II SCSI Card into any slot except number 3. The SCSI card can support up to four SCSI devices when used with ProDOS 1.2 or later and placed in slot 5. In other slots, the card supports only two devices. With versions prior to ProDOS 1.2, the SCSI card can support only two devices, regardless of the slot it is in.

Module Summary

When two devices are connected to the Apple II SCSI Card, the system interprets the device with the higher priority number as Drive 1 and the other as Drive 2.

When four devices are connected to a card in slot 5, ProDOS interprets the two devices with the higher priority numbers as Drives 1 and 2 of slot 5 and the two devices with the lower priority numbers as Drives 1 and 2 of slot 2. This means that if you have three or four devices connected to a card in slot 5, you cannot install a controller card in slot 2 that supports a bootable device such as a floppy disk drive or hard disk.

SCSI Cables

You can extend a SCSI network up to 20 feet (6.5 meters) by using a combination of these three SCSI cables:

System Cable:

- 18 inches long
- connects the computer and first device
- DB-25 connector plugs into port on computer
- protruding 50-pin connector plugs into first device or terminator

Peripheral Interface Cable:

- approximately 3 feet long
- connects one peripheral device to another
- protruding 50-pin connectors on both ends

Cable Extender:

- approximately 3 feet long
- provides means for extending connections between devices beyond the distance met by the System or Peripheral Interface cables
- recessed 50-pin connector connects to Peripheral Interface Cable, terminator or another Cable Extender
- protruding 50-pin connector connects to other peripheral device

Module Summary

Terminators

Terminators are electrically terminated resistors that ensure signal integrity along a SCSI bus. A Cable Terminator is a plastic case containing the terminating resistors. You attach Cable Terminators to SCSI devices or SCSI cables. Some SCSI devices have built-in terminating resistors; for example, all Apple internal SCSI hard disks have built-in terminating resistors. Apple II computers do not use Apple internal SCSI hard disks.

The general rule is that a SCSI network must have two terminators, one between the computer and the first device and the second one just before the last device on the chain. Never set up a network that has more than two terminators.

The exception to the "two-terminator" rule is when you connect just one Apple SCSI device to a computer, close enough for the System Cable to reach, you need only one terminator. The terminator goes on the end of the System Cable, between the cable and the device.

Refer to the section "SCSI Cables and Terminators" for guidelines and examples for positioning terminators.

A SCSI network will not function properly unless the two devices that have terminators are powered on. Other devices without terminators do not have to be on unless you plan to use them.

You have completed this module.

Check your skills and knowledge against the Skills Checklist. When you are ready, take the Module Test.

Module Test

Directions

Answer the following questions as indicated. You may refer to this module while doing this test.

1. What is the maximum number of SCSI devices that you can connect to Apple II computers with ProDOS 1.2 or later?

   _____ devices

2. What is the maximum length for a SCSI network?

   _______ feet

3. Assume that you are setting up a SCSI network that includes an Apple IIGS (with ProDOS 1.2), two Apple external SCSI hard disks, an Apple Tape Backup 40SC, and an Apple LaserWriter SC. All devices have their factory-set SCSI ID numbers.

   a. Would you have to change any of the factory-set ID numbers? If so, for which device(s)? Why? What number(s) would you assign to them?

   [illegible] to 6

   [illegible]

   b. How many Apple II SCSI Cards would you need to install in the Apple IIGS?

   ________ SCSI card(s)

   c. In which slot or slots would you put the SCSI card(s)?

   ____

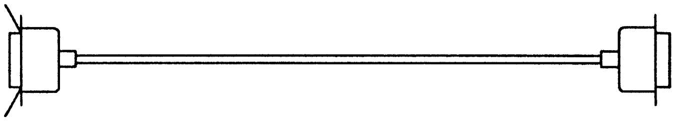
4. Why can't you connect SCSI devices to Apple IIc computers?

   [illegible]

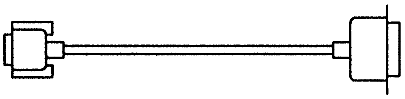
Module Test

5. Match cable names with each of the following SCSI cables. Write the letter corresponding to each cable by its corresponding name.

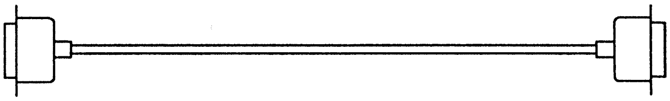
A



B



C



____ System Cable

____ Peripheral Interface Cable

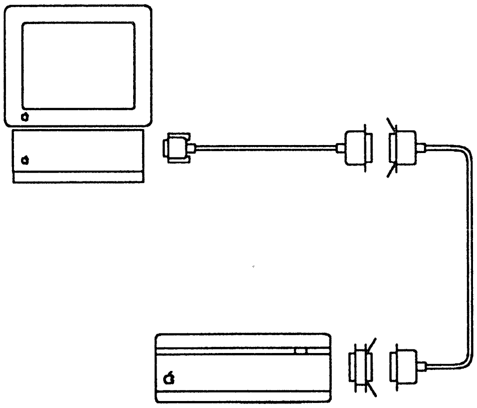
____ Cable Extender

Module Test

Directions

In each of the following items, indicate whether or not the network is properly configured. Are the right cables used? Are enough terminators included and are they positioned properly? What do you think should be changed? Check the option you think is correct.

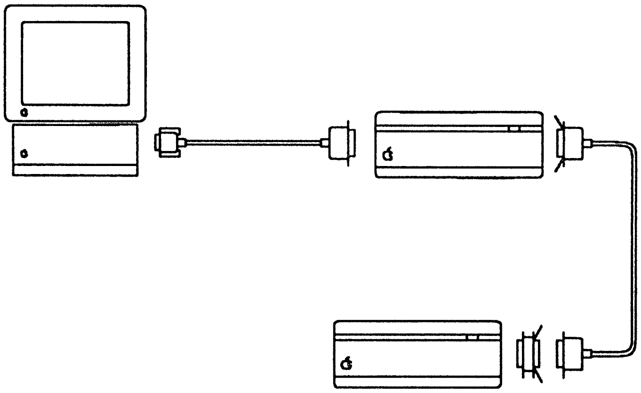
6. Is this system properly configured? If not, how should it be changed?



- A. It is properly configured
- B. Add a Cable Terminator between the Apple IIGS and the System Cable
- C. Add a Cable Terminator between the System Cable and the Cable Extender
- D. Add a Cable Terminator between the Cable Extender and the device
- E. Use a Peripheral Cable instead of the Cable Extender

Module Test

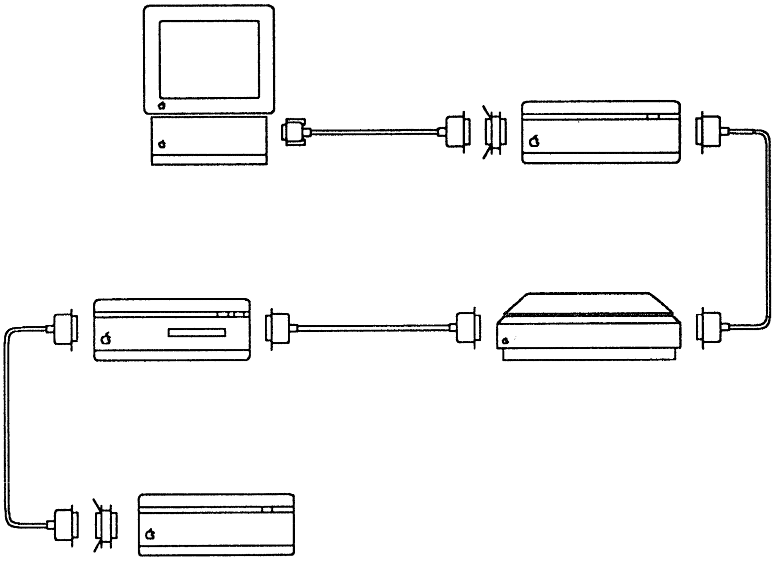
7. Is this system properly configured? If not, how should it be changed?



A. It is properly configured
B. Add a Cable Terminator between the System Cable and the first device
C. Remove the Cable Terminator between the Extender Cable and the last device
D. Use a Peripheral Cable instead of the Cable Extender
E. Add a Cable Terminator between the System Cable and the first device and use a Peripheral Interface Cable instead of the Cable Extender

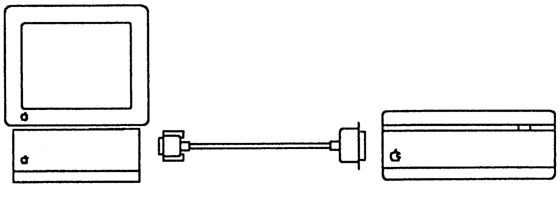
Module Test

8. Is this system properly configured? If not, how should it be changed?



- A. It is properly configured
- B. Remove the Cable Terminator between the System Cable and the first device
- C. Place a Cable Terminator before each device
- D. Move the last Cable Terminator to between the Peripheral Interface Cable and the last device
- E. Use Cable Extenders instead of the Peripheral Interface Cables

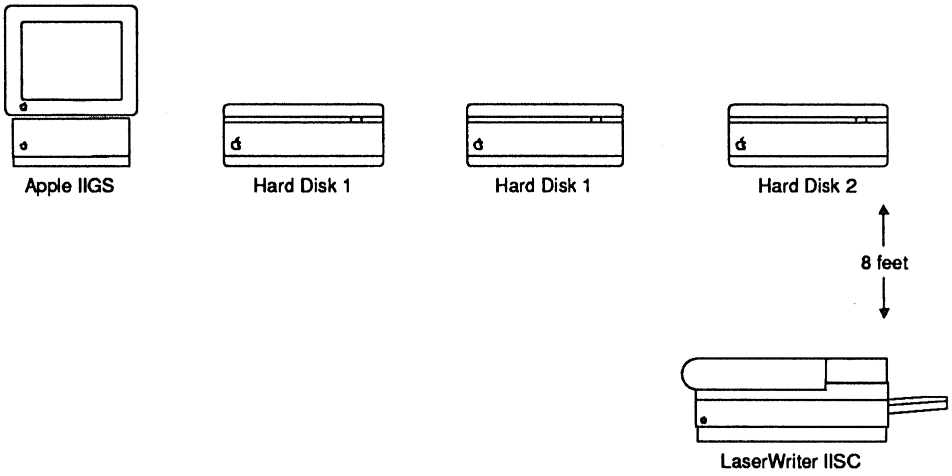
9. Is this system properly configured? If not, how should it be changed?



- A. It is properly configured
- B. Add a Cable Terminator between the Apple II and the System Cable
- C. Add a Cable Terminator between the System Cable and the device
- D. Add a Peripheral Cable and Cable Terminator between the System Cable and the device

Module Test

10. A customer wants to connect three Apple external SCSI hard disks, and an Apple LaserWriter SC to an Apple IIGS. The devices will be arranged as shown in the figure below.



a. List the SCSI cables that the customer needs and state how many of each type are needed.

____

____

b. How many SCSI Cable Terminators would the customer need?

____

c. Where should the terminator(s) be placed?

____

____

Module Test

For items 11 through 15, indicate whether the statements are correct or incorrect by checking TRUE or FALSE.

11. A SCSI network should have a maximum of two Cable Terminators, but there is no limit for built-in terminators.

    ___ TRUE [✓ FALSE]

12. Assign low priority numbers to the least-used devices.

    ___ TRUE ___ FALSE

13. If you want to startup from a hard disk, assign priority 7 to both the computer and the hard disk.

    ___ TRUE [✓ FALSE]

14. When you are setting up a SCSI network, set priority numbers before you plug in the devices.

    ___ TRUE ___ FALSE

15. The devices that have terminators attached to them must be turned on for the SCSI network to communicate properly.

    ___ TRUE ___ FALSE

Module Test

Compare your answers to those on the following pages.

Module Test (Answers)

Directions

Compare your answers to the following:

1. 7 SCSI devices
2. 20 feet
3. a. You would have to change the ID number of one of the hard disks, assign ID 6 to the hard disk designated for startup.
   b. One SCSI card is needed.
   c. slot 5
4. You cannot connect SCSI devices to Apple IIc computers because they do not have slots in which to install Apple II SCSI cards.
5. B - System Cable
   C - Peripheral Interface Cable
   A - Cable Extender
6. C
7. E
8. A
9. C

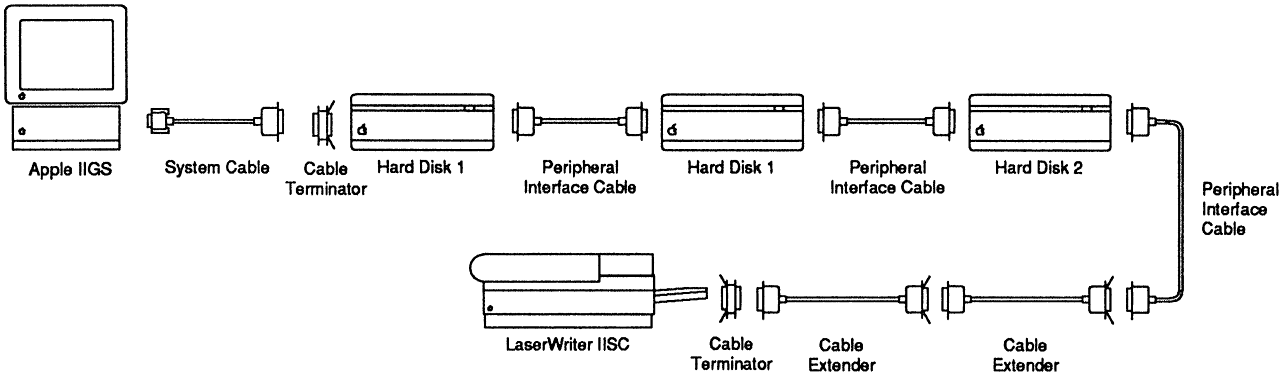
Module Test (Answers)

10. Configured as shown in the figure below, the system would need:

    a. one System Cable
    three Peripheral Interface Cables
    two Cable Extenders

    b. The SCSI network would need two Cable Terminators.

    c. Attach the first Cable Terminator to the System Cable; the second Cable Terminator would attach to the last SCSI cable of the network (Cable Extender or Peripheral Interface Cable).



11. False - A system should never have more than two terminators whether they are built into a device or not.

12. True

13. False. **Never** assign the same SCSI ID (priority) number to two devices on one network.

14. True

15. True

Module Test (Answers)

Check the Skills Checklist to verify that you have acquired the skills and knowledge listed there.

Before continuing with the next module, refer to the evaluation booklet and complete the evaluation for this module.